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ABSTRACT

Certification standards recommended for secondary teaching majors in science and social studies suggest teachers need to specialize in one major area, but study broadly across the discipline. The narrowly defined academic majors of many colleges and universities were considered potential liabilities in achieving a comprehensive science or social studies teaching degree. For a 1-year period, final quarter secondary science and social studies students were given the National Teachers Examination (NTE) Specialty Tests for their respective fields as a measure to assess academic preparation of students with narrow focused majors. In addition, analysis of students' courses of study provided information about students' efforts to broaden their education. Our findings established that those enrolled in the Teacher Certification Program, with rigorous entrance requirements and limited enrollment, are a cohort of predominantly postbaccalaureate students with extensive preparation in their fields. The students' NTE scores ranked in the 80-90th percentile nationally, suggesting they were well prepared academically to teach the broader context assignments in the secondary schools. (Author)

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THE EFFECTIVENESS OF A NARROW FIELD ACADEMIC MAJOR IN PREPARING STUDENTS FOR A BROADER CONTEXT TEACHING ASSIGNMENT

TEACHER EDUCATION RESEARCH CENTER

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PURPOSE OF STUDY

When preparing for a career in teaching, secondary education students at most universities complete requirements for an academic major, as well as for specified education courses. Most student teaching assignments are in the students' major field of preparation. However, science students at the University of Washington typically major in narrowly defined discipline majors, such as biology, physics, or chemistry, but may be assigned to a practicum experience in the more broadly defined teaching field (e.g., physical science). Likewise, social studies students major in specific disciplines as psychology, economics, geography, or political science, but may be assigned to a teaching practicum in a social studies survey course.

The purpose of this study is to determine how well students are academically prepared to teach in the broader science or social studies assignment, given the specific course requirements of respective, narrowly defined majors. A second purpose is to examine students' courses of study to determine patterns of preparation that better prepare students for the student teaching experience.

THEORETICAL BASIS FOR STUDY

The National Association of State Directors of Teacher Education and Certification (NASDTEC) establishes standards for state approval of teacher education. The 1983 NASDTEC recommendations are that teachers specialize in one area of science but study broadly across the sciences to assure a comprehensive program. The concern is for knowledge of processes of science common to several disciplines and an understanding of concepts and principles in several areas. Likewise, for social studies NASDTEC recommends as its general objective "the attainment of a broad understanding of human society and the environmental and cultural factors which shape and condition human life."(1) The program recommendation is for either a subject matter major and supplemental work in another cognate area, or a comprehensive major with a broad base in the social studies.

The narrowly defined academic majors of many colleges and universities may be a liability in achieving a comprehensive science or social studies program. The "narrowness" of an academic major can be defined as the ratio of specific discipline credits to the total number of credits required by the major. For example, at the University of Washington the chemistry major requires 60 total quarter credits, with 40 of them being specifically in chemistry. The resulting percentage (66%) is an index of

narrowness for that major. The higher the percentage, the more narrowly defined the major. Unless students take courses outside of their specialization or peripherally acquire general knowledge in the broader field, they may be inadequately prepared to teach the more broadly defined pre-college courses. Unless additional academic requirements are made of science or social studies students to broaden their experience, the specialized focus of the major may be a limiting factor.

PROCEDURES OF THE STUDY

For one calendar year all secondary science and social studies student teachers took the National Teachers Examination (NTE) Specialty Area Tests at the end of their final quarter in the Teachers Certification Program. Seventeen students took the NTE Specialty Exam for Social Studies. Seven of the science people took the exam for Chemistry, Physics and General Science, while the seventeen earth science and biology majors took the Biology and General Science Specialty Test.

The Teachers Certification Program at the University of Washington is a limited enrollment program, admitting only 120 secondary students a year. Admission standards are rigorous, including a minimum grade point average requirement at or above the overall undergraduate mean computed on the 60 credits earned prior to admission.

Students must also score at or above the 80th percentile (12.9 norms) on the California Achievement Tests. Competition for the openings in the program is strong and it is not unusual for the students to complete their baccalaureate degree before entering the Teacher Certification Program. In this study a majority of participating students had already earned bachelor degrees. Most of the students were classified as fifth year but a few were enrolled in masters degree programs. Among the social studies students, only four of seventeen students were seniors at the time of the exam and only one of seventeen biology-earth science students had not previously earned a bachelors degree. All of the students taking the Chemistry, Physics and General Science exam were post baccalaureate. In addition, all students in the sciences are required to complete an academic minor which may or may not be in the sciences. All social studies students must complete a core course requirement.

The NTE specialty tests are designed to measure understanding of the content and methods. According to the Educational Testing Service (ETS) the reliability estimates of scores on all National Teachers Examination specialty tests have an internal consistency coefficient ranging between .85 and .95. To ensure validity of the tests exam specifications are derived from practitioners, evaluation of current course materials and textbooks, and review by

experts. Level of difficulty and discrimination capability are further criteria for test question selection.

The NTE Specialty exams are required by several states as a minimum competency exit exam for teacher certification. For the purposes of this study it was assumed that science test scores indicate an academic competency in general science and either biological or physical science. Likewise, the scores on the social studies exam indicate competency in the broader social studies field regardless of specific major.

Academic transcripts of all participating students were analyzed for grade point average (GPA) and distribution pattern of course work. To determine narrowness of preparation, the total credits in the specific academic discipline (e.g., political science, psychology, chemistry), were counted, as were the number of credits earned in corraborative courses in the major area of study (e.g., science or social studies.) Narrowness of preparation was thus operationally defined as a ratio of credits in the specific discipline to total credits in the major field. The resulting narrowness scores were compared to a Narrowness Index computed for each major.

Means, standard deviations, and range of scores on the NTE exams were computed for each major field. Scores for each exam were compared to the national norms. Means and ranges were computed for GPA, total credits earned, and

narrowness scores. The NTE scores were correlated with GPA, narrowness of preparation, and total credits earned in the major field. Grade point averages were correlated with narrowness and total credits earned. For each specific discipline represented in the study, score means, percentiles, GPA, narrowness of preparation, and mean number of total credits earned were tabulated.

FINDINGS

Descriptive Data for Science and Social Studies Students

The data collected during the study provide a profile of the final quarter student teacher in both social studies and science. Table I summarizes average scores on the NTE Specialty exams and the corresponding percentile rankings. Grade point averages for each major and composite averages for the corresponding teaching areas are included. For both NTE scores and GPAs, the high-low range of scores is shown.

TABLE I - MEAN NTE SCORES, PERCENTILE RANKINGS AND RANGE OF GPA FOR SOCIAL STUDIES AND SCIENCE MAJORS

MAJOR	N	MEAN NTE SCORES	%-ILE RANK*	NTE RANGE LOW - HIGH		GPA	GPA RANGE LOW - HIGH	
SOC ST	17	679	82	620	770	3.39	2.91	3.86
Hist		686	84			3.35		
Psych		686	83			3.50		
Econ		690	88			3.34		
PolSci		625	66			3.30		
BIO	17	737	87	650	810	3.29	2.89	3.70
Biol		740	87			3.30		
Earth Sc		728	87			3.27		
CHEM/PHY	7	684	85	620	740	3.13	2.83	3.55
Chem		666	82			3.01		
Physics		730	95			3.45		

* Ranks are based upon the 1984 NTE National Norms.

Data were tabulated for 17 students who took the social studies NTE Specialty Test. The average NTE score for this group is 679 which corresponds to the 82nd percentile rank. The highest score of 770 ranks at the 99th percentile, while the lowest score of 620 is above the national mean of 579 and ranks at the 64th percentile. The standard deviation for the social studies NTE exam is 88 points. The grade point average for the social studies students is 3.39. Grade point averages range from 2.91 to 3.86, out of a possible 0 to 4.0.

The total number of science students taking the National Teachers Specialty Exams was 24. Seventeen students took the Biology and General Science Exam. Of these 12 students had a major in biology and the remaining students had an earth science major. Seven students took the Chemistry, Physics and General Science Exam. Two of these students majored in physics and the remaining five in chemistry.

The average score on the Biology and General Science Exam is 737 corresponding to a percentile rank of 87%. The lowest score for the students taking the Biology and General Science exam is 650 and the highest is 810. These scores correspond to 59 and 99 percentile rankings. The standard deviation for this exam is 82 points and the mean national score for this exam is 625. Grade point averages for the

biology and earth science students range from 2.89 to 3.70, with a mean of 3.29.

The scores on the Chemistry, Physics and General Science Exams range from a low of 620 to a high of 740. This compares to national ranks of 67 and 96 percentiles. The mean score for the University of Washington students is 684, with a corresponding percentile rank of 85. The national specialty exam mean for Chemistry, Physics and General Science is 576 with a standard deviation of 87. Grade point averages range from 2.83 to 3.55, with a group mean of 3.13.

Narrowness of Preparation

An analysis of the requirements for each of the represented majors in the social studies field (i.e., history, psychology, economics, and political science) was done to determine the minimum quarter credit requirements and to define, by major, the narrowness of preparation. The same kind of analysis was done for the science majors represented in the study (i.e., biology, earth science, chemistry and physics). Table II gives the minimum quarter credits required for each major, the minimum number of specific discipline credits, and the expected Narrowness Index expressed as a percent. The findings for each social studies and science majors are included in the table. For each major the mean number of total credits earned in the

field and corresponding narrowness of preparation was computed.

TABLE II - QUARTER CREDIT REQUIREMENTS FOR MAJOR AREA, SPECIFIC DISCIPLINE, AND CORRESPONDING NARROWNESS INDEX, COMPARED TO MEAN NUMBER CREDITS EARNED BY MAJOR AND RESULTING NARROWNESS PERCENT

MAJOR	MINIMUM# MAJOR CREDITS	DISCIPLINE CREDITS	NARROWNESS INDEX *	MEAN # CREDITS EARNED	NARROWNESS PERCENT
SOC ST	NA	NA	NA	102	62%
Hist	58	52	.90	101	62%
Psych	50	50	1.00	99	66%
Econ	57	45	.79	104	49%
Pol Sci	50	50	1.00	111	52%
BIOLOGY	NA	NA	NA	123	50%
Biol	47	42	.89	123	68%
Earth Sc	60	25	.40	130	30%
CHEM/PHYS	NA	NA	NA	106	54%
Chem	60	40	.66	96	58%
Physics	64	37	.58	127	44%

*Narrowness Index is a ratio of discipline specific credits to total credits required by the major.

For the social studies group, the mean number of total credits taken within the field is 102, as compared to the University of Washington's minimum requirement for total major credits which range from a minimum of 50 to 60 credits. The ratio of discipline credits to total major credits averaged 62%, while the expected ratios of the Narrowness Index range from .79 to 1.00.

For the sciences, the minimum required number of total major credits ranges from 47 to 64 credits. The students taking the Biology and General Science Exam averaged 125 credits in the academic major with 50% being taken in the

declared discipline. The students in Physics and Chemistry averaged 105 credits, with 53% being in the specific discipline.

In Tables III and IV, the required distribution of courses and quarter credits in each major is compared to the mean number of credits earned by University of Washington students. In social studies, the distribution reflects credits required of the major plus the core courses specified for the social studies teaching certificate. All social studies majors must complete work in economics, geography, U.S. history, world history, and Washington State history. The mean distribution of credits is shown for each major. In the sciences the expected credits reflect requirements of the major, plus courses in other science disciplines, broadly categorized.

TABLE III - REQUIRED DISTRIBUTION OF COURSES AND CREDITS COMPARED TO MEAN NUMBER OF CREDITS EARNED BY STUDENTS IN THE SCIENCES

MAJOR	REQUIRED CREDITS	MEAN NUMBER OF CREDITS EARNED
SCIENCES:		
BIOLOGY (N = 12)		
biology	30	68
chemistry	5	26
physics	0	6
earth sci	0	8
other sci	12	17
EARTH SCIENCE (N = 5)		
biology	10	30
chemistry	10	20
physics	15	11
earth sci	45	48
other sci	0	22
CHEMISTRY (N = 5)		
biology	0	17
chemistry	40	54
physics	15	15
earth sci	0	8
other sci	0	2
PHYSICS (N = 2)		
biology	0	5
chemistry	0	7
physics	37	56
earth sci	0	10
other sci	0	49

TABLE IV - REQUIRED DISTRIBUTION OF COURSES AND CREDITS COMPARED TO MEAN NUMBER OF CREDITS EARNED BY STUDENTS IN SOCIAL STUDIES

MAJOR	REQUIRED CREDITS	MEAN NUMBER OF CREDITS EARNED
SOCIAL STUIDES:		
HISTORY (N = 9)		
history	52	59
economics	3	5
geography	3	6
other	0	22
PSYCHOLOGY (N = 5)		
psych/other	50	70
history	9	18
geography	3	7
economics	3	6
ECONOMICS (N = 1)		
economics	45	5
history	9	30
geography	3	3
other	0	15
POLITICAL SCI (N = 2)		
pol sci/other	50	22
history	9	20
geography	3	7
econ	3	5

Correlational Data

Table V is a set of correlation matrices with the corresponding probability of occurrence identified by asterisks.

TABLE V CORRELATION MATRICES FOR NTE SCORES, GPA, NARROWNESS PERCENTAGE, AND TOTAL CREDITS FOR THE SOCIAL STUDIES AND SCIENCES

SOCIAL STUDIES

	NTE SCORE	GPA	NARROWNESS PERCENTAGE	TOTAL CREDIT
SCORE	1.00			
GPA	.69**	1.00		
NARROW	.30	.60**	1.00	
TOTAL	-.38	-.51*	.63**	1.00

BIOLOGY AND GENERAL SCIENCE

	NTE SCORE	GPA	NARROWNESS PERCENTAGE	TOTAL CREDIT
SCORE	1.00			
GPA	.22	1.00		
NARROW	-.10	-.17	1.00	
TOTAL	.51*	-.03	-.44*	1.00

CHEMISTRY, PHYSICS AND GENERAL SCIENCE

	NTE SCORE	GPA	NARROWNESS PERCENTAGE	TOTAL CREDIT
SCORE	1.00			
GPA	.76**	1.00		
NARROW	-.52	-.66*	1.00	
TOTAL	.57	.63	-.55	1.00

* Indicates probability of less than .05
** Indicates probability of less than .01

The GPA correlated with the NTE scores on the Chemistry, Physics and General Science Exam (r = .76) and was significant at the .01 level Likewise, the correlation on the Social Studies Exam was meaningful educationally, (r = .69) and significant at the .05 level. There was no significant correlation between GPA and NTE scores for the Biology and General Science Exam.

On the other hand, a positive correlation was found between the NTE score on the Biology and General Science

Exam and the total number of credits taken in the sciences. There were no comparable findings for the groups taking either the Chemistry, Physics and General Science Exam or the Social Studies Exam.

The narrowness of preparation was not found to correlated significantly with NTE scores on any exams. Narrowness of preparation correlated positively with GPA for Social Studies, ($r = .60$, $p = .01$) but correlated negatively with GPA for Chemistry, Physics and General Science ($r = -.66$, $p = .05$). The correlation of narrowness of preparation with GPA for Biology and General Science was a low negative number.

The mixed results that emerged from the correlations led us to construct a series of graphs. Figure I shows the relationship between the mean number of total credits and the narrowness scores for each major area. The second figure shows the relationship between the mean number of total credits and the percentile rank on the NTE exams. Figure III demonstrates the relationship between the narrowness of preparation and the percentile rank on the NTE specialty exam.

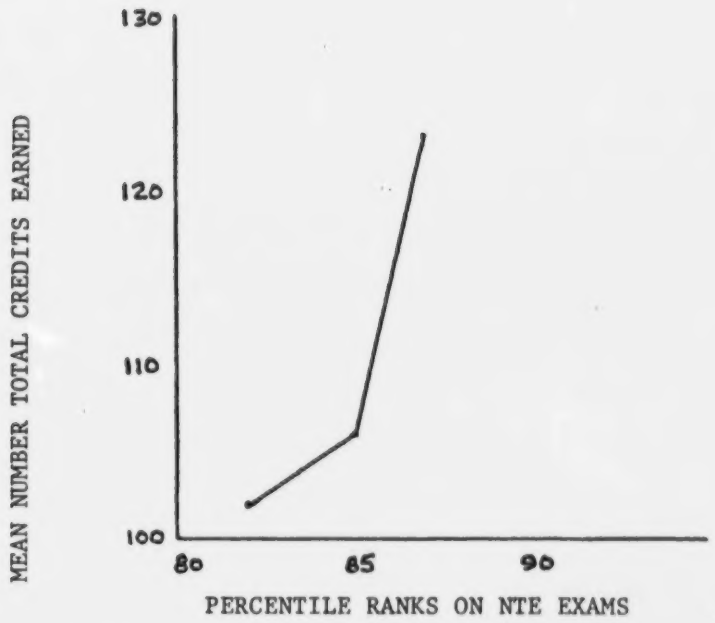

FIGURE 1 - Relationship Between Percentile Ranks on NTE Specialty Exams and Meant Total Credits Earned

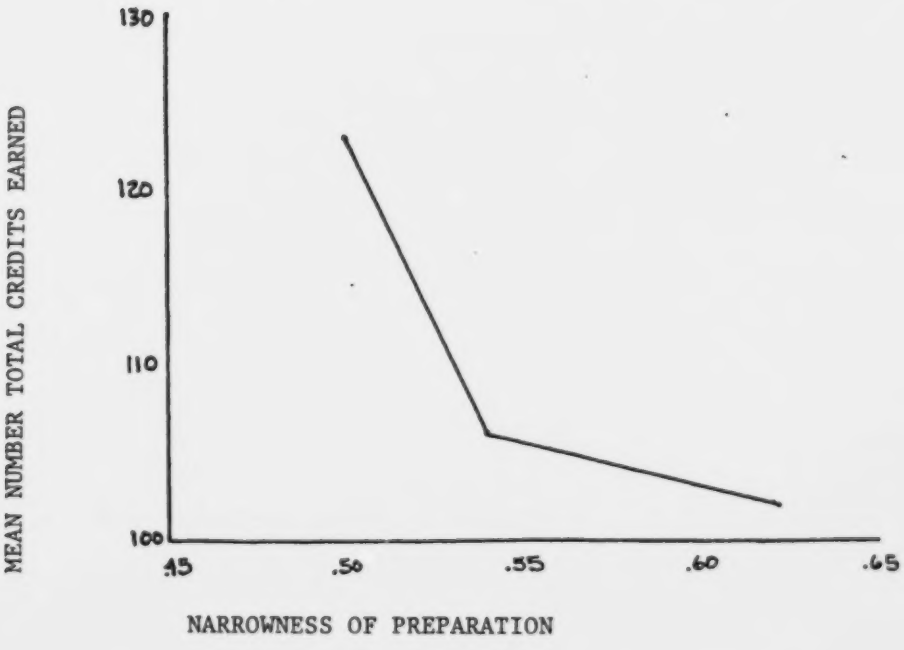

FIGURE 2 - Relationship Between Narrowness Of Academic Preparation and Mean Total Credits Earned

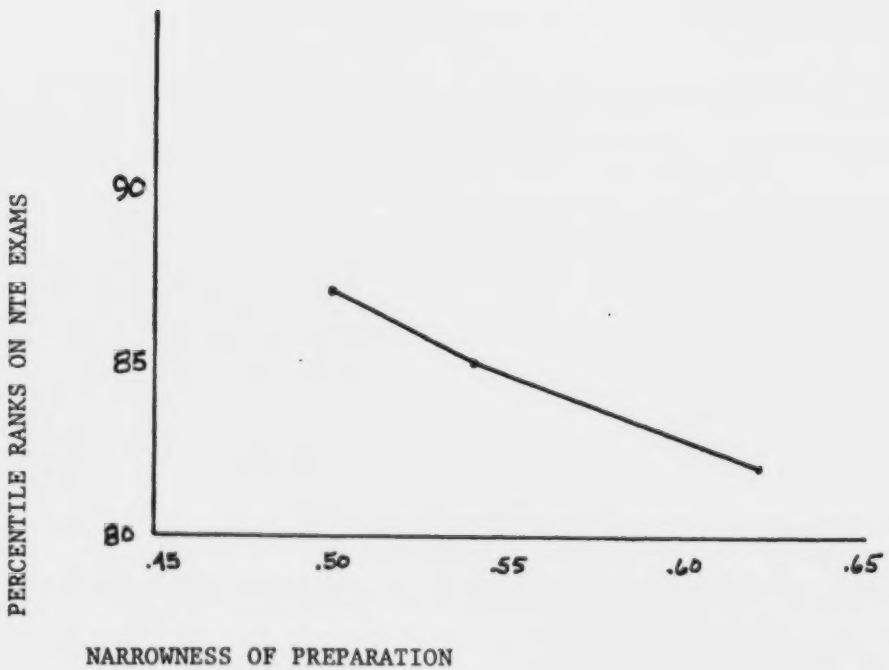

FIGURE 3 - Relationship Between Narrowness of Academic Preparation and NTE Rank

The graphs demonstrate a consistent pattern. As credits in the major field increase, the narrowness of preparation decreases, and the percentile rank on NTE increases. The trend in Graph III shows that narrowness of preparation corresponds negatively to the percentile ranking.

CONCLUSIONS

The initial impetus for this study was a concern for students preparing for the teaching profession in academic fields which are more restrictive in scope than the broader instruction at the K - 12 level. Would a rigorous, narrow degree program cause subsequent difficulties in the more generalized field? Although the sample size was small in number, the participants in the study reflect the caliber of student accepted into the Teacher Certification Program.

The data for the students were tabulated according to the broad field of study. Overall, the students achieved above the national mean for each of the Specialty Area Tests. The percentile rank for the mean scores was 82%, 87% and 85% respectively for the Social Studies exam, Biology and General Science exam, and for the Chemistry, Physics and General Science exam. The lowest scores for each of these exams ranked the students in the 64th, 59th and 67th percentiles respectively.

If one assumes the Specialty Area Tests broadly represent the discipline, then successful achievement on the test would mean that students have an adequate preparation in the field to teach these subjects to school children. Given the findings it would appear that the students tested in this study are well prepared academically to teach the range of courses offered in their field at the secondary schools.

The data, however, clearly demonstrate that these students completed nearly twice the required number of courses for the major, and their preparation for the teaching area was broadened as a consequence. This finding may be explained by the fact that the majority of students in the Teacher Certification Program are fifth year students who have already received a bachelors degree prior to program admission. It may also be a result of requirements necessary to convert a specialized science or social science major (eg. Fisheries or Black Studies) into a Biology or Social Studies teaching major.

The correlations between GPA and the NTE scores for the Social Studies and Chemistry, Physics and General Science tests were strong and statistically meaningful, while those for Biology and General Science were low and non-significant. It should be remembered that the GPA is calculated on the 60 credits earned prior to admission into the Teacher Certification Program. Students tend to receive

better grades in their specific discipline and given the more narrow preparation and fewer total credits of the chemistry-physics and social studies students, compared to the Biology and General Science examinees, the result may be an artifact of the point in time at which the study was conducted. Perhaps if the social studies and chemistry-physics students increased their total number of credits while broadening their course of study, their GPAs would decrease.

The most compelling result of the study was the interrelationships of credits earned, narrowness of preparation and percentile ranks for NTE. The trend towards broadening of knowledge with the increase in number of credits and a corresponding increase in NTE percentiles seems to support the notion that narrow academic majors negatively impact a student's academic preparation in the broader range of secondary school subjects. However, certain caveats are in order. First, each NTE test is normed on different populations and therefore percentile ranks may not correspond. Second, the graphs utilize data points which may not be by themselves statistically significant. Finally, the number of students involved in the study was relatively small.

The apparent direction reversal of correlations between social studies and sciences raises additional questions. In studying the program pattern, social studies people seem to

become more narrow in focus as credits increase. This suggests the students are specializing, even though the Teacher Certification Program requires some study in a core area. On the other hand, science students seem to broaden in studies with increased credits. Upon consideration, this may be a result of a Teacher Certification Program requirement that all science students must complete a minor. The minor is not required to be in science, but science students often select corroborative minors from the broader field of science. If the pattern holds true it might be useful to investigate the effect that having an academic minor has on the NTE score and the GPA.

Given the rigorous admission requirements for the University of Washington's Teacher Certification Program, (2) and the preponderance of fifth year or graduate students, it is reasonable to assume the narrowly defined academic majors do not present a serious problem for University of Washington students teaching in the broader field. The additional time spent in academic studies seems to enhance their scores on an exit exam for teacher preparation and should likewise enhance their performance in the profession. In any case, this study does suggest consideration of the teacher certification program as strictly a fifth year or graduate level program, in that the additional academic time seems to enhance preparation.

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